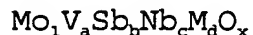


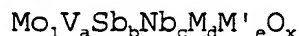
WHAT IS CLAIMED IS:

1. A catalyst composition for production of an unsaturated carboxylic acid from an alkane comprising a compound of the formula:



wherein Mo is molybdenum, V is vanadium, Sb is antimony, Nb is niobium, M is gallium, bismuth, silver or gold, a is from 0.01 to 1, b is 0.01 to 1, c is 0.01 to 1, d is 0.01 to 1, and x is determined by the valence requirements of the other elements present.

2. The catalyst composition of Claim 1 wherein the formula is:



wherein M' is tantalum, titanium, aluminum, zirconium, chromium, manganese, iron, ruthenium, cobalt, rhodium, nickel, platinum, boron, arsenic, lithium, sodium, potassium, rubidium, calcium, beryllium, magnesium, cerium, strontium, hafnium, phosphorus, europium, gadolinium, dysprosium, holmium, erbium, thulium, terbium, ytterbium, lutetium, lanthanum, scandium, palladium, praseodymium, neodymium, yttrium, thorium, tungsten, cesium, zinc, tin, germanium, silicon, lead, barium and thallium and e is 0.0 to 1.

3. The catalyst composition of Claim 2 wherein M is gallium.

4. The catalyst composition of Claim 3 wherein M' is tungsten.
5. The catalyst composition of Claim 1 wherein a is 0.01 to 0.75.
6. The catalyst composition of Claim 5 wherein a is 0.1 to 0.5.
7. The catalyst composition of Claim 6 wherein a is 0.3.
8. The catalyst composition of Claim 1 wherein b is 0.01 to 0.5.
9. The catalyst composition of Claim 8 wherein b is 0.1 to 0.5.
10. The catalyst composition of Claim 9 wherein b is 0.15.
11. The catalyst composition of Claim 1 wherein c is 0.01 to 0.5.
12. The catalyst composition of Claim 11 wherein c is 0.1 to 0.5.
13. The catalyst composition of Claim 12 wherein c is 0.05.

14. The catalyst composition of Claim 1 wherein d is 0.01 to 0.5.

15. The catalyst composition of Claim 14 wherein d is 0.1 to 0.1.

16. The catalyst composition of Claim 15 wherein d is 0.03 to 0.06.

17. The catalyst composition of Claim 2 wherein e is 0.0 to 0.5.

18. The catalyst composition of Claim 17 wherein e is 0.0 to 0.01.

19. The catalyst composition of Claim 1 selected from the group consisting of  $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.15}\text{Nb}_{0.05}\text{Ga}_{0.03}\text{O}_x$ ,  $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.08}\text{Nb}_{0.05}\text{Ga}_{0.03}\text{O}_x$ ,  $\text{Mo}_1\text{V}_{0.3}\text{Nb}_{0.05}\text{Sb}_{0.15}\text{Bi}_{0.03}\text{O}_x$ ,  $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.15}\text{Nb}_{0.05}\text{Ag}_{0.06}\text{O}_x$ ,  $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.15}\text{Nb}_{0.05}\text{Au}_{0.015}\text{O}_x$  and  $\text{Mo}_1\text{V}_{0.3}\text{Nb}_{0.05}\text{Sb}_{0.15}\text{Ga}_{0.03}\text{W}_{0.012}\text{O}_x$ .

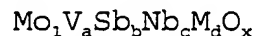
20. The catalyst composition of Claim 1 wherein the catalyst composition is supported on an inert support.

21. The catalyst composition of Claim 20 wherein the inert support is silica, alumina, niobia, titania, zirconia and mixtures thereof.

22. The catalyst composition of Claim 1 wherein the catalyst composition is formed into powder, granules, spheres, cylinders or saddles.

23. A process of making a catalyst composition for production of an unsaturated carboxylic acid from an alkane comprising:

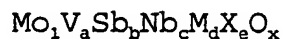
- a) forming a solution of a molybdenum compound, a vanadium compound, an antimony compound, a niobium compound and a compound of gallium, silver or gold;
- b) mixing the solution to form a uniform solution;
- c) removing liquid from the uniform solution to form a solid;
- d) drying the solid;
- e) calcining the solid to form a catalyst of the formula:



wherein Mo is molybdenum, V is vanadium, Sb is antimony, Nb is niobium, M is gallium, silver or gold, O is oxygen, a is from 0.01 to 1, b is 0.01 to 1, c is 0.01 to 1, d is 0.01 to 1 and x is determined by the valence requirements of the other elements present.

24. The process of Claim 23 wherein the solution additionally comprises one of more compounds of M' wherein M' is one or more elements selected from the group consisting of tantalum, titanium, aluminum, zirconium, chromium, manganese, iron, ruthenium, cobalt, rhodium, nickel, platinum, boron,

arsenic, lithium, sodium, potassium, rubidium, calcium, beryllium, magnesium, cerium, strontium, hafnium, phosphorus, europium, gadolinium, dysprosium, holmium, erbium, thulium, terbium, ytterbium, lutetium, lanthanum, scandium, palladium, praseodymium, neodymium, yttrium, thorium, tungsten, cesium, zinc, tin, germanium, silicon, lead, barium and thallium to form a catalyst of the formula:



wherein e is 0 to 1.0.

25. The process of Claim 24 wherein M is gallium.

26. The process of Claim 25 wherein M' is tungsten.

27. The process of Claim 23 wherein a is 0.01 to 0.75.

28. The process of Claim 27 wherein a is 0.1 to 0.5.

29. The process of Claim 28 wherein a is 0.3.

30. The process of Claim 23 wherein b is 0.01 to 0.5.

31. The process of Claim 30 wherein b is 0.1 to 0.5.

32. The process of Claim 31 wherein b is 0.15.

33. The process of Claim 23 wherein c is 0.01 to 0.5.

34. The process of Claim 33 wherein c is 0.1 to 0.5.
35. The process of Claim 34 wherein c is 0.05.
36. The process of Claim 23 wherein d is 0.01 to 0.5.
37. The process of Claim 36 wherein d is 0.1 to 0.1.
38. The process of Claim 37 wherein d is 0.03 to 0.06.
39. The process of Claim 23 wherein e is 0.0 to 0.5.
40. The process of Claim 39 wherein e is 0.0 to 0.1.
41. The process of Claim 23 wherein the molybdenum compound is ammonium paramolybdate, molybdenum oxide, molybdic acid or molybdenum chloride.
42. The process of Claim 23 wherein the vanadium compound is ammonium metavanadate, vanadium oxide, vanadium oxalate or vanadium sulfate.
43. The process of Claim 23 wherein the niobium compound is niobium oxalate, ammonium niobium oxalate, niobic acid, hydrous niobium oxide or niobium oxide.

44. The process of Claim 23 wherein the niobium compound is formed from a solution of a dicarboxylic acid or a tricarboxylic acid and niobic acid dissolved in water.

45. The process of Claim 44 wherein the dicarboxylic acid is oxalic acid.

46. The process of Claim 44 wherein the dicarboxylic acid is malonic acid, succinic acid, glutaric acid or adipic acid.

47. The process of Claim 44 wherein the tricarboxylic acid is citric acid.

48. The process of Claim 23 wherein the antimony compound is antimony oxides, antimony chlorides, antimony sulfate, antimony tartrate or antimony acetate.

49. The process of Claim 23 wherein the silver compound is silver oxide, silver acetate, silver carbonate, silver nitrate or silver chloride.

50. The process of Claim 23 wherein the gallium compound is gallium oxide, gallium nitrate, gallium chloride, gallium acetylacetonate or gallium sulfate.

51. The process of Claim 23 wherein the bismuth compound is bismuth acetate, bismuth hydroxide, bismuth nitrate, bismuth nitrate hydrates, bismuth(III) nitrate oxide, bismuth(III) oxide, bismuth citrate, bismuth fluoride, bismuth chloride, bismuth bromide, bismuth iodide, bismuth(III) oxychloride, bismuth(III) oxynitrate, bismuth(III) phosphate, bismuth subcarbonate, bismuth subnitrate, bismuth subnitrate monohydrate, bismuth subsalicylate or bismuth(III) sulfide.

52. The process of Claim 23 wherein the gold compound is gold bromide, gold chloride, gold hydroxide, gold iodide or hydrogen tetrachloroaurate.

53. The process of Claim 24 wherein the compound of M' is an oxalate, a tartrate, a citrate, a nitrate, a halide, a carbonate, a bicarbonate, a hydroxide or an oxide.

54. The process of Claim 23 additionally comprising supporting the catalyst on an inert support.

55. The process of Claim 54 wherein the inert support is silica, alumina, niobia, titania, zirconia and mixtures thereof.

56. The process of Claim 23 wherein the liquid solvent is removed by filtration, evaporation or centrifuge.



57. The process of Claim 56 wherein the liquid solvent is removed by evaporation.

58. The process of Claim 23 wherein the liquid is removed and the solid is dried by spray drying.

59. The process of Claim 58 wherein the spray drying outlet temperature is in the range from 90°C to 105°C.

60. The process of Claim 23 wherein calcining occurs in an inert gas.

61. The process of Claim 60 wherein the inert gas is argon or nitrogen.

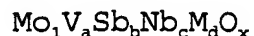
62. The process of Claim 23 wherein calcining is at a temperature in the range of 550-650°C for 1 to 10 hours.

63. The process of Claim 23 additionally comprising ballmilling, grinding or crushing the catalyst after calcining.

64. The process of Claim 23 wherein the catalyst is selected from the group consisting of  $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.15}\text{Nb}_{0.05}\text{Ga}_{0.03}\text{O}_x$ ,  
 $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.08}\text{Nb}_{0.05}\text{Ga}_{0.03}\text{O}_x$ ,  $\text{Mo}_1\text{V}_{0.3}\text{Nb}_{0.05}\text{Sb}_{0.15}\text{Bi}_{0.03}\text{O}_x$ ,  
 $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.15}\text{Nb}_{0.05}\text{Ag}_{0.06}\text{O}_x$ ,  $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.15}\text{Nb}_{0.05}\text{Au}_{0.015}\text{O}_x$  and  
 $\text{Mo}_1\text{V}_{0.3}\text{Nb}_{0.05}\text{Sb}_{0.15}\text{Ga}_{0.03}\text{W}_{0.012}\text{O}_x$ .

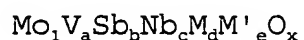
65. A process for producing an unsaturated carboxylic acid from an alkane comprising:

contacting an alkane and molecular oxygen with a catalyst composition of the formula:



wherein Mo is molybdenum, V is vanadium, Sb is antimony, Nb is niobium, M is gallium, silver or gold, a is from 0.01 to 1, b is 0.01 to 1, c is 0.01 to 1, d is 0.01 to 1, and x is determined by the valence requirements of the other elements present.

66. The process of Claim 65 wherein the catalyst composition is of the formula:



wherein M' is tantalum, titanium, aluminum, zirconium, chromium, manganese, iron, ruthenium, cobalt, rhodium, nickel, platinum, boron, arsenic, lithium, sodium, potassium, rubidium, calcium, beryllium, magnesium, cerium, strontium, hafnium, phosphorus, europium, gadolinium, dysprosium, holmium, erbium, thulium, terbium, ytterbium, lutetium, lanthanum, scandium, palladium, praseodymium, neodymium, yttrium, thorium, tungsten, cesium, zinc, tin, germanium, silicon, lead, barium and thallium and e is 0.0 to 1.

67. The process of Claim 65 wherein M is gallium.

68. The process of Claim 67 wherein M' is tungsten.
69. The process of Claim 65 wherein a is 0.01 to 0.75.
70. The process of Claim 69 wherein a is 0.1 to 0.5.
71. The process of Claim 70 wherein a is 0.3.
72. The process of Claim 65 wherein b is 0.01 to 0.5.
73. The process of Claim 72 wherein b is 0.1 to 0.5.
74. The process of Claim 73 wherein b is 0.15.
75. The process of Claim 65 wherein c is 0.01 to 0.5.
76. The process of Claim 75 wherein c is 0.1 to 0.5.
77. The process of Claim 76 wherein c is 0.05.
78. The process of Claim 65 wherein d is 0.01 to 0.5.
79. The process of Claim 78 wherein d is 0.1 to 0.1.
80. The process of Claim 79 wherein d is 0.03 to 0.06.
81. The process of Claim 65 wherein e is 0.0 to 0.5.

82. The process of Claim 81 wherein e is 0.0 to 0.1.

83. The process of Claim 65 selected from the group consisting of  $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.15}\text{Nb}_{0.05}\text{Ga}_{0.03}\text{O}_x$ ,  $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.08}\text{Nb}_{0.05}\text{Ga}_{0.03}\text{O}_x$ ,  $\text{Mo}_1\text{V}_{0.3}\text{Nb}_{0.05}\text{Sb}_{0.15}\text{Bi}_{0.03}\text{O}_x$ ,  $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.15}\text{Nb}_{0.05}\text{Ag}_{0.06}\text{O}_x$ ,  $\text{Mo}_1\text{V}_{0.3}\text{Sb}_{0.15}\text{Nb}_{0.05}\text{Au}_{0.015}\text{O}_x$  and  $\text{Mo}_1\text{V}_{0.3}\text{Nb}_{0.05}\text{Sb}_{0.15}\text{Ga}_{0.03}\text{W}_{0.012}\text{O}_x$ .

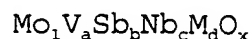
84. The process of Claim 65 wherein the catalyst composition is supported on an inert support.

85. The process of Claim 84 wherein the inert support is silica, alumina, niobia, titania, zirconia and mixtures thereof.

86. The process of Claim 65 wherein the catalyst composition is formed into powder, granules, spheres, cylinders or saddles.

87. A process of ammoxidation of alkanes and olefins comprising:

contacting an alkane or olefin with molecular oxygen and ammonia in the presence of a catalyst composition of the formula:



wherein Mo is molybdenum, V is vanadium, Sb is antimony, Nb is niobium, M is bismuth, silver or gold, a is from 0.01 to

1, b is 0.01 to 1, c is 0.01 to 1, d is 0.01 to 1, and x is determined by the valence requirements of the other elements present.

88. The process of Claim 87 wherein the alkane is propane to produce acrylonitrile.

89. The process of Claim 87 wherein the alkane is isobutane to produce methacrylonitrile.